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PREVENTING NON-CONFORMANCES USING VALUE ENGINEERING

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ABSTRACT

This paper documents a method to use Function Analysis System Technique (FAST) modeling techniques to prevent non-conformances in systems or processes. The key to this technique is to make unwanted functions the primary task function for FAST modeling. This "forcing technique" provides a deeper understanding of "why" and "how" non-conformances are occurring and yields outstanding speculation phase results on how to prevent reoccurrences.

INTRODUCTION

In this paper, I'll describe how I used Value Engineering (VE) to attack a quality problem. I'm calling the technique I developed "Negative FAST". It is very similar to a technique known as "reverse brainstorming". Some value practitioners may already use a similar approach but I've seen few developed examples in the literature. The purpose of my paper is two-fold:

- To show how I used Negative FAST to attack a quality problem
- To speculate on how this approach can be applied to similar problems

BACKGROUND

The U.S. Army Industrial Operations Command (IOC) Value Engineering Division began doing white collar VE studies in February 1996. We used a standard VE approach:

- Develop a sequence flow (including time & cost data)
- Perform function analysis and FAST modeling
- Identify value mismatches
- Develop alternatives
- Implement better value alternatives

However, our Quality Assurance people asked us to look at a problem they had with ammunition that didn't meet specifications. Specifically, the IOC had made some ammunition that wasn't meeting United Nations Performance Oriented Packaging (UN-POP) requirements. The IOC has to meet the UN-POP standard to ship its ammo.

UN-POP marking is labeling that describes the type of ammunition being shipped, its hazard classification, and weight. Producers put the label on the outside of the shipping box. The marking must be factually correct and meet label format and letter height criteria. Here's an example of a UN-POP marking label:

UNITED NATIONS MARKINGS

U/N 4A1 / Y81 / S / 89
USA / DOD / ***

4 = Box
A = Steele
1 = Closed Head
Y = Container passed for packing groups II or III
81 = Max gross wt in kilograms box was tested (178 lbs)
USA = State (country) of manufacture
DOD = Registered symbol by DOD with DOT
*** = Reflects code assigned to activity

Figure 1

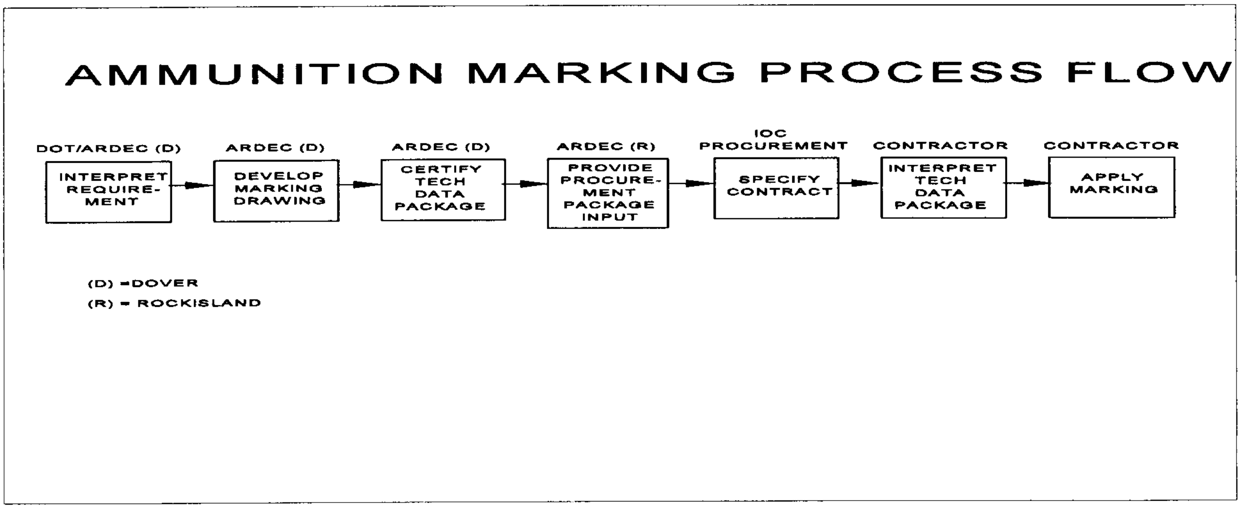

Figure 2

Figure 2 is a flow chart that describes the UN-POP marking process. This is a very high level process flow. Each step in this process has many sub-processes that need to occur to successfully apply UN-POP marking labels.

When our study effort began we didn't know what part of the process or sub-process was causing the non-conformances.

Based on the complexity of the process flow, not knowing the exact cause of the non-conformances, and because of the potential cost involved to study every process step, I realized that I needed some effective way of studying this problem within our limited resources. But how?

FUNCTION ANALYSIS

I began thinking about the purpose of Function Analysis and FAST modeling. Eventually, after lots of head scratching, I developed the following syllogism:

- All process activities are caused by functions
- Non-conformances result from process activities

Therefore:

- Non-conformances are caused by functions

Isn't this true? As value practitioners we constantly hear "all cost is for function". I began to think that we could determine the functional causes of our non-conformances and develop ways to prevent them.

As a study team, our first step was to build a Cause and Effect (C&E) diagram for all of the non-conforming ammo we had data on. We divided the diagram into three categories: people, process, and materials. We assigned all of the non-conformances to one of the three categories. We had some instances where materials were the primary problem: labels that fell off, and an incorrect letter stamp. We had some instances where the process was the problem. In this case where the process didn't work fast enough at incorporating technical data changes. But most of our problems were people related - instances where people made costly mistakes in judgement.

After we built our C&E diagram, our next step was to build a FAST model. But instead of a typical FAST model we built one using the function "mismark ammo" as our primary task function.

This is an important distinction and the key to this whole technique. I call this a "forcing technique". What I mean by this is that I'm creating what is in some ways an artificial construct. I'm exploring the functional causes of some function which I don't want.

Our mission was to develop the functional causes of this primary task. This was similar to describing the function operations of any normal process. However, in this case, all of the functions were unwanted. To do this we used the Cause and Effect diagram as our departure point. From the Cause and Effect diagram, we knew the specific causes of the non-conformances but by using abstract functional definitions we could creatively develop ways to eliminate the non-conformance.

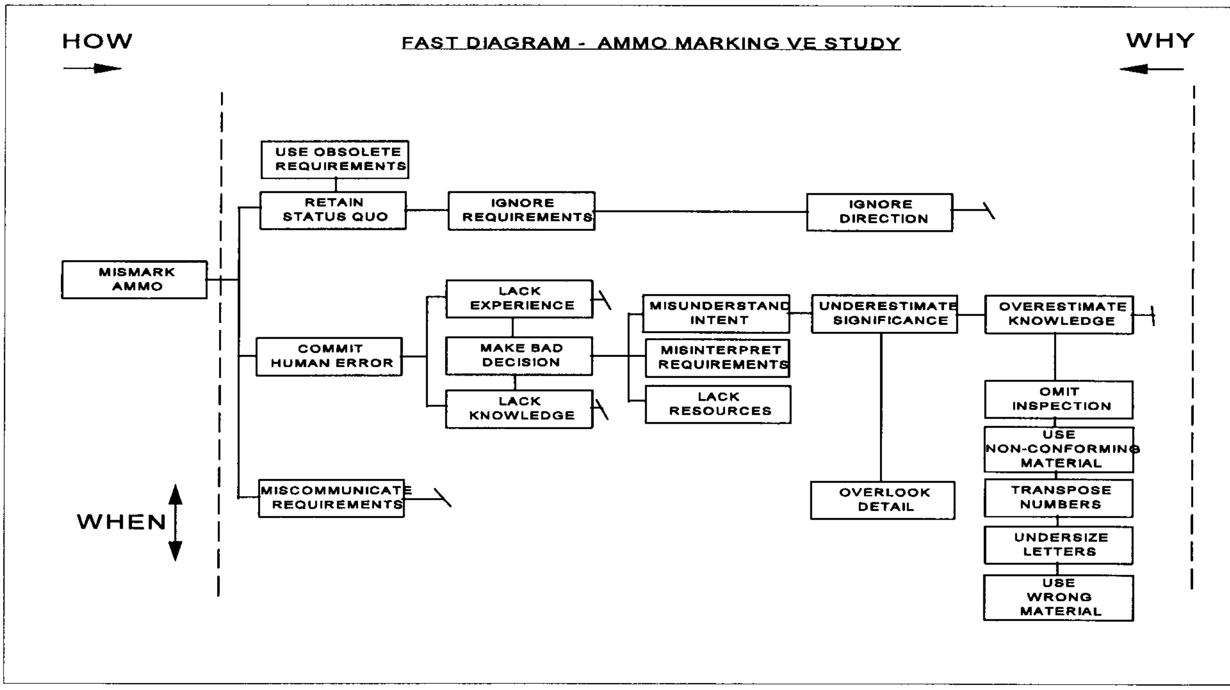

Figure 3

Our FAST model is at Figure 3.

Think of this model as a game. The question becomes, "How can we mismark ammunition?" This question reveals two ways to play the game: one is to take a "theoretical" approach starting from the primary task and building the model using only the team's experience and judgement; the other is to abstract from real non-conforming examples using the C&E diagram as the starting point.

In our case we ended up doing a little of both. We were able to attribute patterns of certain types of non-conformances to a functional cause. We also developed some functions purely by speculation.

SPECULATION

The Negative FAST speculation phase focus is not "How else do I do something?" but instead "How do I prevent or eliminate something?" This approach retains all the advantages of classical VE speculation because it still uses **Function** as the creative starting point. The use of functions, because of their reliance on abstraction, offers the study team a lot of flexibility to develop plausible problem solutions.

After developing potential ways to prevent or eliminate non-conformances the study team can apply them to the system that produced the non-conformances. Listed below are all the potential solutions our team brainstormed on the function "Miscommunicate Requirements":

- Use common language
- Verify
- Provide feedback
- Verify feedback
- Simplify instructions
- Standardize instructions
- Ensure understanding
- Reduce ambiguity
- Minimize opportunities for errors
- Reduce excessive requirements
- Use plain English
- Take more time in providing requirements
- Sender take responsibility
- Learn from bad communication
- Follow-up to ensure message received
- Provide all the facts
- Timely updates to requirements and drawings
- Ensure communicating latest revisions
- Standardize requirements between services

This list of ideas can serve as the basis for reexamining the system that produces the non-conformances: in this case faulty UN-POP marking. These brainstorming results become design parameters for the system itself. Does the system do these things that will reduce the chance of error? For example, is there feedback in the system? Are POP marking instructions simplified so that producers can ensure compliance? And so on.

We then transitioned these ideas to all the process owners for their use in redesigning their systems.

OTHER EXAMPLES

Let me develop another example of how this approach might work.

One of the highlights of the 1996 SAVE International Conference was a presentation by Captain Al Haynes, a former United Airlines pilot, describing the crash landing of United Airlines Flight 232 in Sioux City, Iowa on July 19, 1989.

Captain Haynes's tale was very interesting because in it he described the teamwork required to deal with unexpected change. It was a very inspiring story of how a team can work together to overcome adversity.

For those not familiar with the story, Captain Haynes was piloting a United DC-10 flight from Denver to Chicago when, during the flight, a fan disk in the No. 2 engine located in the tail of the aircraft disintegrated, severing all three of the aircraft's main hydraulic lines. This caused a loss of control of all of the plane's control surfaces.

Captain Haynes then described how working as a team he, his co-pilot, the flight engineer, and a United pilot who was flying in the jump seat, controlled all aspects of the plane's flight using only the planes engines.

While developing my ideas on how to use function analysis and FAST for non-conformances I thought of how to model this situation.

The FAST model I developed is at Figure 4.
This model offers a chance to brainstorm on how to prevent these functions from occurring. For example, here's a short list of ideas I've developed to prevent these functions from occurring:

Function: Sever Hydraulics

- Move hydraulics
- Move engines
- Harden hydraulics casing
- Harden fuselage
- Develop self sealing hydraulic fluid

Function: Pierce Casing

- Develop hardened "puncture-proof casing"
- Absorb shrapnel

Function: Produce Shrapnel

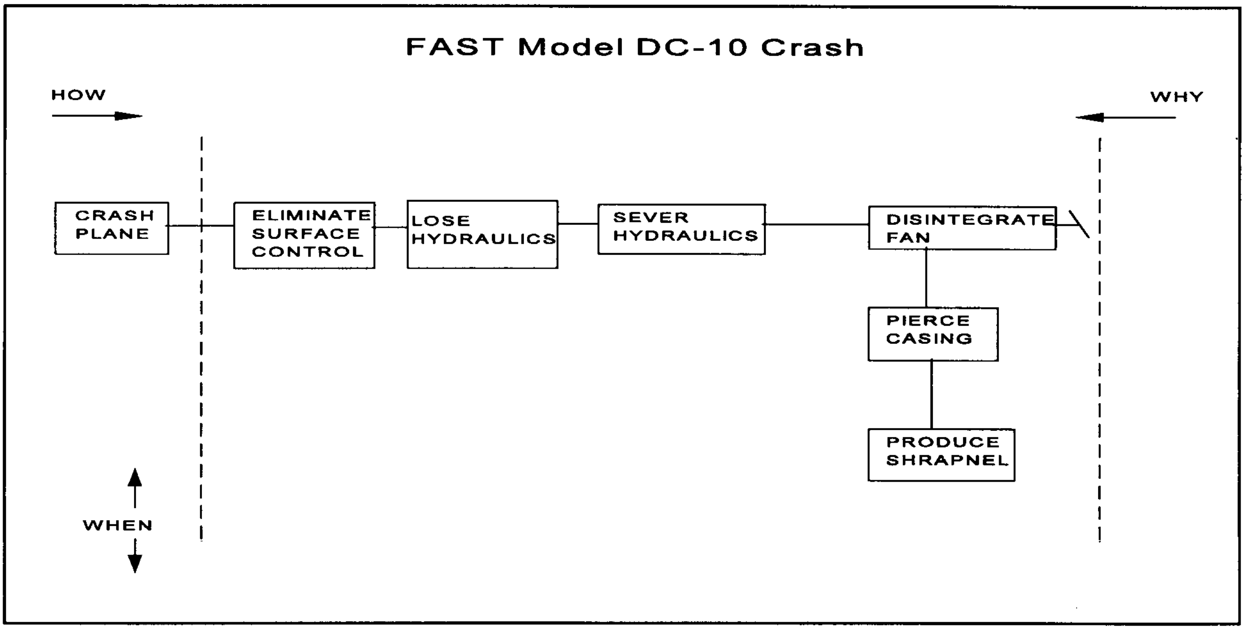

Figure 4

- Use materials that won't penetrate upon disintegration

Function: Disintegrate Fan

- Use alternate materials
- Change maintenance practices

Function: Lose Hydraulics

- Use mechanical controls
- Use electromechanical controls
- Use lasers
- Use radio control

These are only some of the possible ways to prevent these functions from occurring.

SUMMARY

In this paper I've described how to use function analysis and FAST modeling in a way not typically used by most value practitioners.

The key to the technique is to develop a FAST model using an unwanted function as the primary task function. By doing this the VE study team can use the same analytical techniques to eliminate unwanted functions that they would use to improve needed and wanted functions.

The question that remains is this: Is this technique really useful and does it merit further development?

I leave that question for you, my fellow value practitioners, to answer.

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